Emergency Pulse Rate Monitoring and Detecting the Location of Handicapped People using an Embedded System

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Abstract

The wearable devices have long been used for various factors like for personal security purpose, for detecting multiple health parameters such as sleep apnea, blood pressure etc. Smartphones have become one of the necessary gadgets of our daily routine. So we can use its potential to make our lives more efficient and advanced. This project is specially built considering the handicapped peoples' needs which describes the Android Application that will continuously monitor the pulse rate of the user & collect the data. The user just needs to press the power button on the smartphone for the predefined time to send this data to the nearest people whenever he/she will feel insecure or weak. The location of the user will be sent through the text message in an emergency situation and also alarm will generate. This message includes the pulse rate details, contact number and changes in the location of handicapped people so that further emergency actions will be taken. The GPS system and KNN algorithm are be used to finding out the nearest people of the user.

Keywords- (K Nearest Neighbors) KNN, (Global Positioning System) GPS, Heart Rate, Arduino, Photoplethysmography (PPG)

I. INTRODUCTION

A heartbeat rate is a vital parameter to determine whether a person is normal or not as a person's physical and emotional fitness affect the heart rate [2]. It changes according to the situations for example during exercise heart rate increases as body requires more oxygen, fever, illness, dehydration of body are also responsible for heart rate increase and normal range of heart rate increase is 75 to 80 bpm while aging, resting, meditation these are some factors which cause the decrease in heart rate which normally can be between 40 to 60 bpm. Scientifically heartbeat can be defined as 'the sound of the valves in the heart contracting or expanding as they circulate blood from one region to other and 'heart rate' is nothing but 'the number of times the heart beats per minute(bpm) which is also called as 'pulse rate.' Usually, normal person in normal condition has 60 to 100 bpm heart rate. It can be checked at chest using a stethoscope as well as at the wrist by placing two fingers between the bone and the tendon over the radial artery.

There are so many conditions where people with physical disabilities are unable to express their condition and they do not get help in emergency situations. In such cases, wearable sensor devices can help them [5]. Nowadays there are multiple wearable sensor devices which can be used for this purpose like chest straps, wristwatches, clothing, necklace etc. [2]. These devices can be very useful to elderly people as well as a person with heart deceases. So we can merge these two technologies of smartphone and wearable sensors to make the heart rate monitoring simpler and a way more efficient [1]. Technology has always played an important role to make medical facilities more efficient but sometimes it is not affordable to common people. Thus we have worked on the low cost and convenient system containing the android application and an embedded system for continuous heart rate monitoring and detecting the location of handicapped people.

The rest of paper is organized as per the following parts. Section II describes the related work which has been implemented before and motivation behind the proposed work, section III contains the proposed system, hardware, and software description, section IV consists of the working and general analysis of the system, section V contains the conclusion of the whole work.

II. RELATED WORK

Ref. No.	*Technique used*	*Advantage*	*Disadvantage*
[1]	*The principle of Photoplethysmography is used to calculate heartbeat, 'Health Kit Store' to process the collected data and SOS Heart app to access the data.*	*Detects the medical issues as well as the location of the user.*	*Only available for iPhone users.*
[2]	*A Heart Beat (HB) sensor is developed using Light Dependent Resistance (LDR) and Light Emitting Diode (LED)*	*Precise, straightforward and cheaper than other heartbeat rate measuring systems.*	*Complete hardware system*
[3]	*1) Each person is tracked and segmented.* *2) Attribute-based multi-gait model.* *3) Attribute detection.*	*Better recognition performance than traditional gait recognition methods when multiple people walking together.*	*1)Not able to capture the inherent intra-class variability of each class.*
[4]	*Digitally sensing and displaying the body temperature and heart rate on the Android using Arduino*	*Multi-gait Recognition*	*1)Not able to capture the inherent intra-class variability of each class.*
[5]	*A wearable sensor device for heart rate monitoring based on photoplethysmography (PPG).*	*Analyzes of the light variations in biological tissues*	*Hard to maintain a huge set of records.*
[6]	*1.Data sampling & segmentation is performed* *2. An exhaustive set of the statistical and morphological part is extracted from each data segment.* *3. Localization & AR-Node localization*	*The accuracy of 90.8% even if the sensor nodes are miss-oriented.*	*wastage of resources can occur*
[7]	*The device is built to measure the PTT (Pulse Transit Time) which is then converted to BP using appropriate fitting functions.*	*Validation of measurements on different postures and subjects is performed.*	*Confusion can be occurred to handle the resources*
[8]	*FPGA (Field Programmable Gate Arrays) kit is used as a central processing unit. The result is transmitted serially to a Bluetooth module via UART communication Protocol.*	*Describes the development of a System-on-a-chip (SOC) based wearable system for the measurement of Blood Pressure which will act as CNBP system*	*Only the blood pressure is measured*
[9]	*A novel wearable sensor device is used to continuously monitor the movements and cardiac parameters at the wrist. But it is used to find out the sleep structure and sleep disorders.*	*98% pulse intervals are correctly detected.*	*Continuous monitoring only for 48 hours*
[10]	*A wireless terminal is developed with the help of sensor technology, IoT technology and wireless technology to calculate pulse rate and body temperature.*	*It can be successful in real time and give the 95% accuracy.*	*Accuracy is limited to only within the certain wireless area.*

A. Issues and Challenges

So the above survey shows that different SOC based systems using Arduino, FPGA (Field Programmable Gate Array) and beagle bone platforms are built which can measure the heart rate & body temperature also. But there are so many limitations in these pulse rate monitoring systems Like miss orientation of sensor localization, lack of accuracy in the result, bad internet connection etc. which can be reduced using newer technologies.

There are lots of scope for further enhancements in wearable systems, for example, making use of a computer to display the heart rate output, optimization of resource allocation, the system for remote monitoring etc. Almost all existing systems work on GPS for outdoor location detecting which provides accuracy up to 15 to 20 meters only. So these limitations of current systems are the great motivation behind this project. Here, a continuous monitoring system which will send indoor, as well as outdoor alert messages just by pressing the power button of the smartphone is developed. It mainly focuses on the requirements of physically disable or old people for the cheaper rate.

III. PROPOSED WORK

Fig. 1:

Hardware requirements are-
System Processors: Core2Duo
Hard disk: 150 GB
Speed: 2.4GHZ
Embedded System Containing
1) Sensor Module
2) Control Unit Arduino UNO
3) Bluetooth Module HC05
Android Mobile-Marshmallow Software which has been used isOS: 32bit Windows 7 & 64bit Windows 10
Coding language: Java 1.8
IDE: Android Studio 3.0.1
Database MySQL
Scripting Language: PHP
The detailed working of system and algorithms is-

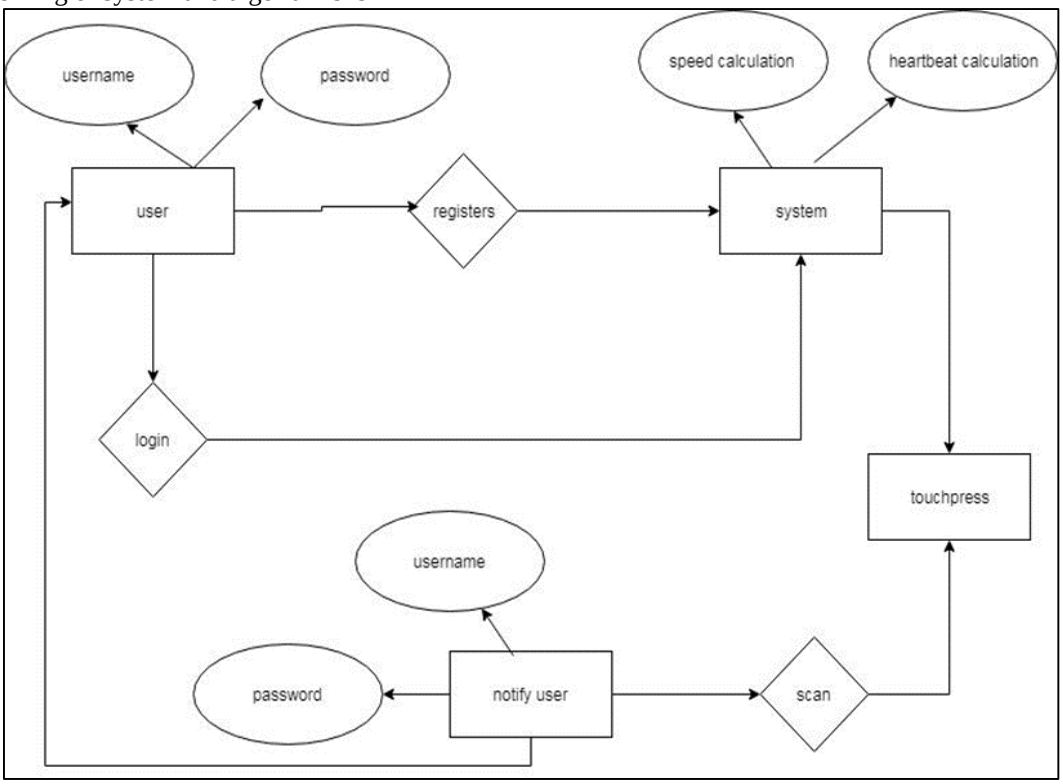
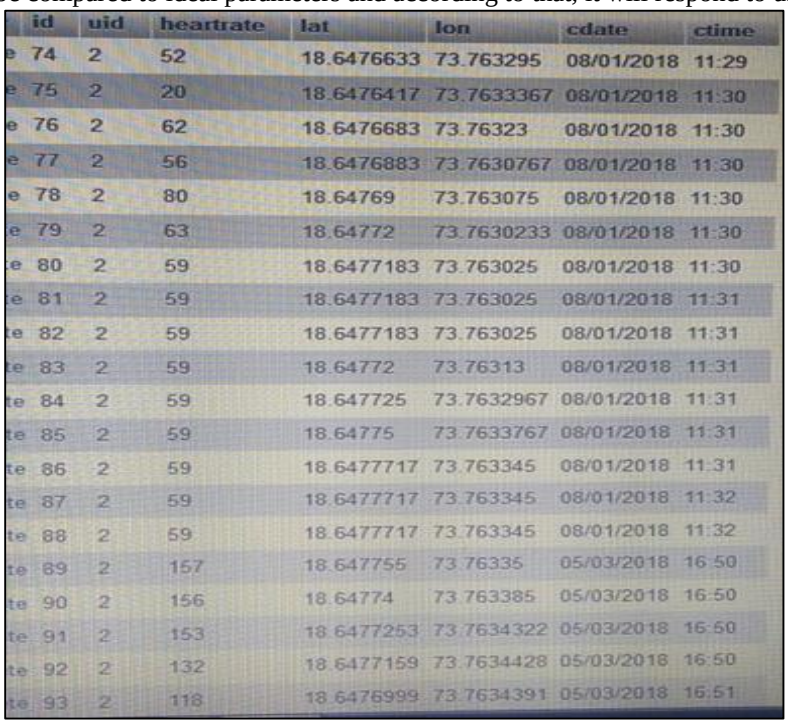


Fig. 2:

A system is built using pulse rate sensor pin which has LED and a photo diode, Arduino UNO, Bluetooth module HC05 for connecting to the smartphone and 9V battery. The user needs to sign in the app and fill the personal data like name, birth date, health issue, phone no. which will be required to store for emergency situations.

Fig. 3:

Then information of at least two relatives must be added so that according to emergency user will get help by its nearest user. As soon as the finger is placed in pin it will start monitoring the pulse rate using LED and LDR. These two work on the photoplethysmography principal. This data is collected as long as the finger is placed in a pin and stored in MySQL database. Then using PHP language it will be compared to ideal parameters and according to that, it will respond to user's requests.



id	uid	heartrate	lat	lon	cdate	ctime
74	2	52	18.6476633	73.763295	08/01/2018	11:29
75	2	20	18.6476417	73.7633367	08/01/2018	11:30
76	2	62	18.6476683	73.76323	08/01/2018	11:30
77	2	56	18.6476883	73.7630767	08/01/2018	11:30
78	2	80	18.64769	73.763075	08/01/2018	11:30
79	2	63	18.64772	73.7630233	08/01/2018	11:30
80	2	59	18.6477183	73.763025	08/01/2018	11:30
81	2	59	18.6477183	73.763025	08/01/2018	11:31
82	2	59	18.6477183	73.763025	08/01/2018	11:31
83	2	59	18.64772	73.76313	08/01/2018	11:31
84	2	59	18.647725	73.7632967	08/01/2018	11:31
85	2	59	18.64775	73.7633767	08/01/2018	11:31
86	2	59	18.6477717	73.763345	08/01/2018	11:31
87	2	59	18.6477717	73.763345	08/01/2018	11:32
88	2	59	18.6477717	73.763345	08/01/2018	11:32
89	2	157	18.647755	73.76335	05/03/2018	16:50
90	2	156	18.64774	73.763385	05/03/2018	16:50
91	2	153	18.6477253	73.7634322	05/03/2018	16:50
92	2	132	18.6477159	73.7634428	05/03/2018	16:50
93	2	118	18.6476999	73.7634391	05/03/2018	16:51

Fig. 4:

When user will press the power button for predefined time text message will be sent to the relatives through GPS as well as the alarm will be ON. If the location of user changes and heart rate suddenly increases simultaneously then the message will be sent to the police station. The process of sending alert messages is done by using KNN (K Nearest Nodes) algorithm.

A. Working on KNN Algorithm

It is one of the simplest machine learning algorithm used for classification and regression. Let's consider the following diagram where two different classes named as 'Red' and 'Blue' are described.

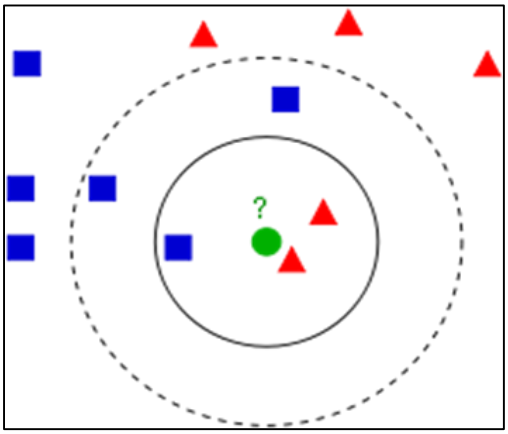


Fig. 5:

Also K=3 for a solid line
K=5 for a dotted line
To find out the class of green circle we will make the cluster of nearest nodes according to the values of k.
Here for k=3, there are 2 Red class members nearby it and for k=5 there are 3 Blue class members near to it. So we can observe that 2 is very near to its 'k' value. Hence green member will be part of cluster 'Red'.
It takes the Euclidean distance i.e. the distance between two points in Euclidean space to find out the very nearest person. It is given by the formula-

$$d_E(x,y) = \sum_{i=1}^{N} \sqrt{{x_i}^2 - {y_i}^2}$$

Where,
Xi=longitude
Yi=latitude

B. Working of GPS

There are 31 satellites in the orbit which are continuously transmitting data to the GPS receivers about their current time and location. The smartphone receiver includes channels, processors and highly stable clock. There must be six satellites in the view of the receiver for exact location tracing but minimum four satellites are required for the location tracking. Three are for longitude, latitude, altitude and other for the clock deviation. Also, accelerometer sensor is used for the speed calculation. If the person moves from one place to other these parameters also get changed and if the user's location of the smartphone is enabled then it can be traced easily. But variations in on-body sensor locations and gait phases can affect the expected outcomes. There is future scope to increase the accuracy of speed and distance measurement.

C. Result

The system can be used for real-time purposes and has 90% accuracy rate which can be changed according to other factors like internet range, on-body sensor locations etc. If the GPS is disabled or user is not within the strong internet range then it will be difficult to trace the location as well as send the notification. The main benefit of application is that it saves time because of power button feature and KNN algorithm which is the non-assumption algorithm. It has an extra benefit of emergency alarm also.

IV. CONCLUSION

The system can be used for continuous pulse rate monitoring, detecting the location of the user & sending an alert message to the nearest people with them and there are few features to improve.

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